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PRECISION VACUUM-TYPE PLANTER HEAD[1/]

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Plant scientists have searched for years to find a precision planter that accurately places individual seeds in the soil at equal spacing. Uniform plant population and spacing are needed to evaluate the production in many scientific studies, such as fertilizer trials, weed control, varietal tests, or insect control.

The geneticist needs seedlings equally spaced to study characteristics of individual plants; the agronomist needs this spacing to study growth and production and to study the effect of plant population; the entomologist and the fertilizer specialists need it to determine the influence of insects and fertilizer on seed production.

The high cost of hybrid seeds, the scarce supply of new improved seed varieties, and the need for equal spacing in mechanical harvesting have forced the seed industry to re-evaluate its planting equipment and procedures. Studies indicate that quality seeds with a high purity and germination can be planted at low seeding rates, yet give excellent performance in production and product uniformity.

The scarcity of available hand labor is forcing the use of mechanical harvesting. Equal spacing of rows and of plants in the rows encourages uniform growth of plants and maturity of fruit which contributes materially to the success of mechanical harvesting.

Agricultural engineers of the Agricultural Research Service, U.S. Department of Agriculture, in cooperation with the Oregon Agricultural Experiment Station designed and constructed a precision planter and fertilizer applicator (figure 1) for research agronomists doing research on seeding rates for grass and legume seeds.[3/] The machine picks up a single seed mechanically and drops it through a short tube into a furrow. The machine has been used several seasons and does an excellent job in seeding legume seeds, but leaves much to be desired with many of the grass seeds.

1/ Cooperative investigations between the Agricultural Engineering Research Division, Agricultural Research Service, U.S. Department of Agriculture, and the Oregon Agricultural Experiment Station.

2/ Agricultural engineer, Agricultural Engineering Research Division, Agricultural Research Service, U.S. Department of Agriculture, located at Corvallis, Oregon.

3/ Harmond, J. E., Rampton, H. H., and Yoder, E. E. Precision Planter and Fertilizer Applicator for Use on Experimental Plots. U.S. Dept. Agr. Miscl. Pub. 962, 16 pp., 1965.

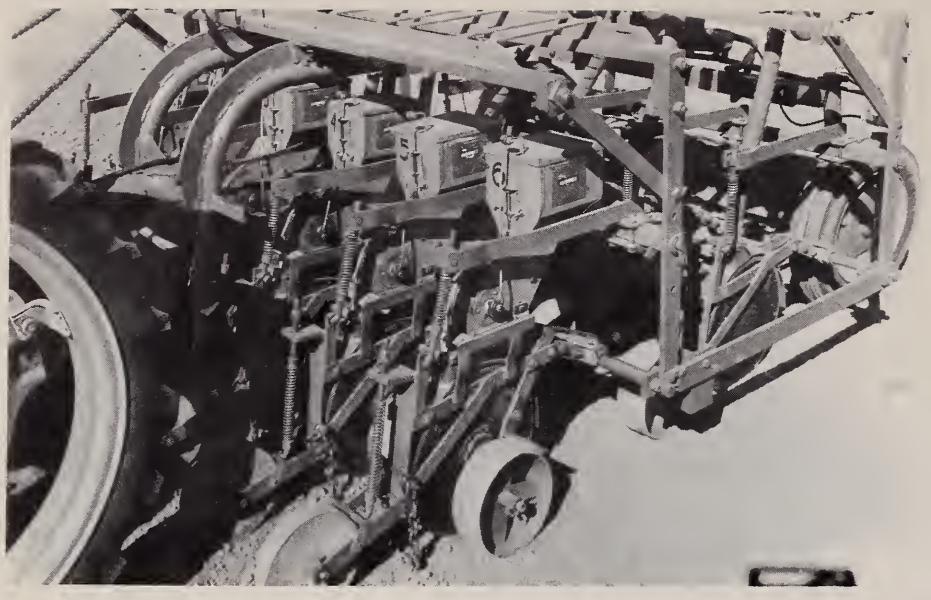

Figure 1. Closeup view of precision planter showing seed hoppers, pick-pickup wheels, opener disc, depth regulator wheel, cover drag chain, and spring-loaded weighted picker wheel.

In an effort to produce a planting device for both legume and grass seeds, a vacuum-type planter head was developed by the agricultural engineers (figure 2). This unit consists of a revolving vacuum head connected to a vacuum pump through a tube located in a stationary shaft. The head is fitted with radial nozzles and is rotated around the shaft by a roller chain and sprockets. As the head revolves, the nozzles pass up through a seedbed where the vacuum draws seeds over the nozzle openings and holds them as the wheel rotates, until a stationary spring-loaded slide shoe breaks the vacuum and releases the seed. An air jet connected to the pressure side of the vacuum pump cleans the nozzle before it reenters the seedbed to pick up another seed. Using the correct nozzle size and vacuum, each nozzle picks up a single seed and drops it at the same relative position on each cycle. The planter head can be ground-driven through roller chain and sprockets connecting it to the tractor wheel. A series of easily changed sprockets gives a wide selection of seed rates as the planter head rotation can be changed in steps as low as three 1/1000 of a revolution per linear foot of tractor travel.

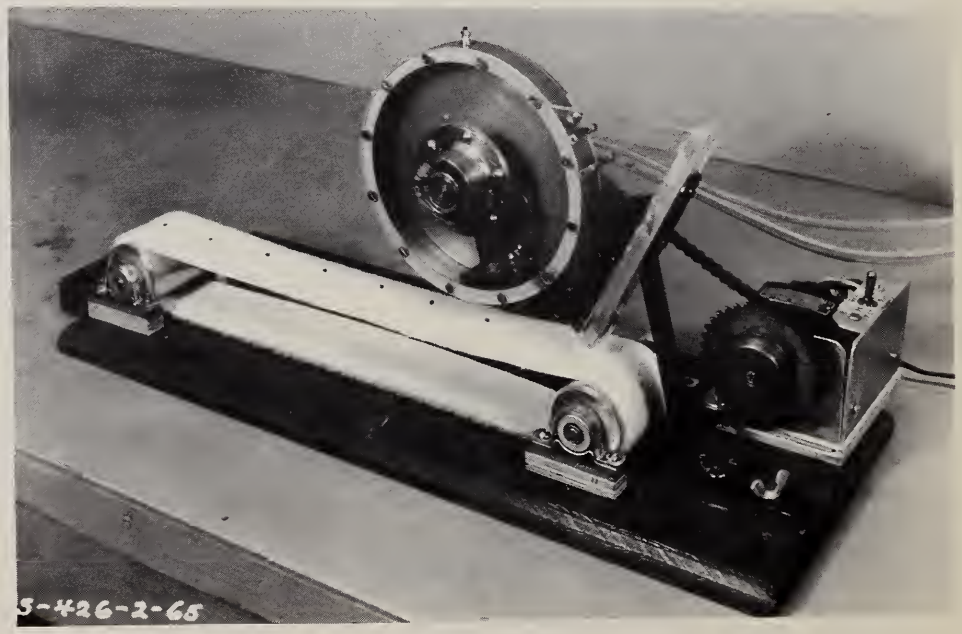

Figure 2. Demonstration model of the vacuum planter head with plastic cover showing slide shoe that breaks the vacuum releasing the seed, and plastic tube that delivers exhaust air from the vacuum pump that discharges through the nozzles to clean them. Note the seed placement on the belt when the unit is operated with subterranean clover.

By installing the proper drive gears, the number of seeds per foot of planter travel can be accurately controlled at any desired rate from a single seed to several hundred seeds. The vacuum head should be located near the ground so that the seed will be released only a few inches above the bottom of the furrow.

In preliminary tests the seed placement pattern was virtually perfect. The different size suction nozzles required to handle various size seeds are made by using a standard Zerk[4/] grease fitting as the base and inserting the size nozzle required to handle the particular seed size (figure 3). The nozzle can be changed by merely screwing out one Zerk fitting and replacing it with one containing the correct size nozzle. This facilitates a quick change from one size to another and permits the use of one size vacuum head for the entire range of seed and nozzle sizes. For seeds like carrot, where several rows are planted close together in a single seedbed, a cylinder-type suction head that is wide enough to accommodate the several rows that go into a single seedbed can be used. For large seeds like beans, 0.125 inch diameter holes are used to provide a vacuum on a larger area of the seed. For seeds like subterranean clover and safflower seed, openings of 0.0625 inch seem to be the correct size, but for alfalfa, red clover, tomato, and small grass seeds, 0.030 inch size nozzle openings are required. For lettuce and ladino clover, a 0.020 inch opening was used.

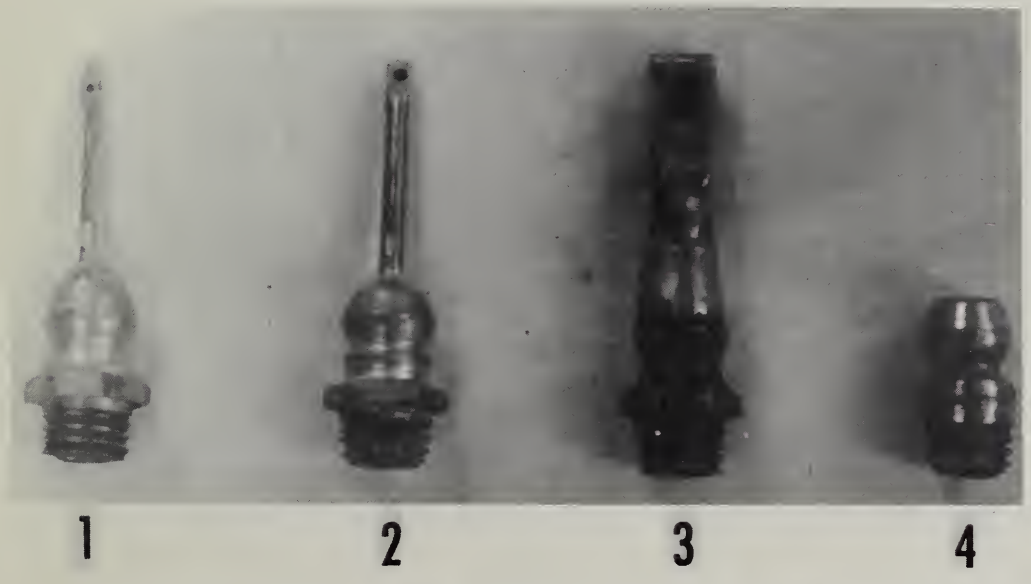

Figure 3. Vacuum-type planter head pickup nozzles. No. 1 has a 0.020 inch side opening; No. 2, a 0.0625 inch side opening; No. 3, a 0.125 inch side opening; and No. 4, a 0.061 inch end opening.

Another nozzle design that has improved seed pickup is a hollow needle that is about 1 inch long, closed at the tip, and open on one side. As the needle passes through the seed mass, the hole is on the leading edge. Once seeds are drawn to the hole, they have the mechanical aid of the needle to push them through the seedbed. This materially reduces the number of empty needles or misses by the planter.

4/ Trade names are used in this publication solely for the purpose of providing specific information. Mention of a trade name does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture or an endorsement by the Department over other products not mentioned.

Based on preliminary laboratory tests, where the vacuum planter head is rotating and dropping clean seeds on a movable belt, the results indicate that the planter will handle legumes, cereal grains, vegetable, grass, flower, and tree seeds. With the correct size nozzle and the required vacuum, the unit will accurately plant many seeds, regardless of their shape or size. A vacuum of 12 inches of water is sufficient for handling most seeds, whereas a vacuum of 60 inches is needed for heavy, dense seeds such as beans. Most positive pressure blowers will provide up to 192 inches, which is far more than that required for the vacuum planting operation. Air volume requirements for the planter are low, therefore even small commercial positive pressure blowers similar to those used as superchargers on diesel engines are large enough to handle as many as six planter heads.

Vacuum-type planters are not new. I. C. Sweetman reported one in 1957[5/] and in 1958, Beauford A. Silbaugh and Robert J. Metzger of Crops Research Division, Agricultural Research Service, U.S.D.A., constructed a four-row vacuum planter similar to the Sweetman machine. After a few refinements, the machine has been successfully used to seed thousands of wheat-breeding research plots. Another unit was developed by the Soil Conservation Service, Equipment Development Center, in Arcadia, Calif., to plant forest tree seeds. One was developed by W. V. Clow, W. V. Clow Seed Company, Salinas, Calif., to plant lettuce seed; and another by E. Helm, Agronomy Department, Montana State University, Bozeman, Mont., for planting corn. Agricultural engineers at the University of Idaho, and others also have worked on vacuum planters.

The plot planter and fertilizer applicator described in U.S.D.A. Miscellaneous Publication No. 962 can be used to plant any kind of seed when the mechanical pickup wheel is replaced with the vacuum-type head discussed in this report. The planter was designed for use in research plots, but with slight modification it can be used on farms.

The complete unit is a self-propelled machine that is easily and quickly adjusted for a wide range of seeding rates, seed depths, fertilizer rates, and fertilizer positions related to the seed.

The machine handles each seed separately and places it in a row at a preset distance from the preceding seed. Row spacing can be adjusted from 12 inches up to 6 feet. Speedometers and revolution counters are located in easy view of the operator so adjustments can be readily made for consistent operation.

Precision seeding offers many advantages to the farmer in operations ranging from planting to marketing. It saves seed because fewer seeds need to be planted. It reduces production costs because there is less thinning to be done. The plant spacing helps in obtaining uniform plant growth and fruiting which is an aid to mechanical harvesting, and it improves product quality because each seed has an equal chance to grow and fruit to its fullest potential.

5/ Sweetman, I. C. A suction-operated precision seeder. New Zeal. Jour. Sci. and Technol. Sec. A, 38:576-582, illus. 1957.